

NOTES ON THE ETHOLOGY OF *EFFERIA ARGYROGASTER*
(DIPTERA: ASILIDAE) IN MEXICO^{1,2}

ROBERT J. LAVIGNE

Entomology Section, Plant Science Division, Box 3354, University of Wyoming, Laramie, Wyoming 82071.

Abstract.—The behaviors exhibited by *Efferia argyrogaster* (Macquart) in Mexico differed very slightly from those exhibited by other species of *Efferia*. Foraging efficiency was poor. Prey manipulation occurred occasionally while the asilid hovered above the feeding site. The list of recorded prey was dominated by Hymenoptera, which is unusual among *Efferia* species. Males exhibited simple undulating search flights for females, which resulted in the typical male atop female copulatory position when contact was made. Females deposited eggs in available niches in dead dry vegetation.

Efferia argyrogaster (Macquart), which was described in 1846 from specimens collected in Merida, State of Yucatan, Mexico, by M. Pilate, was originally assigned to the genus *Erax*. The only other reference to this species was a subsequent description based on a single male from Tehuantepec, Mexico, by Hine (1919), who suggested that *E. triton* and *E. argyrogaster* might be the same species. The specimens, upon which this paper is based were identified by Dr. Joseph Wilcox, 7551 Vista del Sol, Anaheim, California 92805, who is the leading taxonomist on the *Efferia* of the New World.

Nothing has been reported concerning the behavior of *E. argyrogaster*. The following observations were made during a five day stay (March 24–28, 1972) in the vicinity of Santa Cruz de la Solidar, State of Jalisco, Mexico, near Chapalla. The population studied was encountered in an abandoned rocky field, which had, at some previous time, been plowed and planted to maize (Fig. 1). The population appeared to be limited to the immediate area

¹ Published with the approval of the Director, Wyoming Agricultural Experiment Station, as Journal Article JA 993.

² This paper reports on work supported in part by National Science Foundation Grant GB29617X, Comparative Behavior of the Dipteran Family Asilidae.



Fig. 1. Abandoned field habitat of *Efferia argyrogaster*. Santa Cruz de la Solidad, Mexico.

and the total number probably did not exceed 25 individuals. Population counts made on two different days provided a male to female sex ratio in percent, of about 40:60 on those days.

As with other species of *Efferia*, foraging efficiency of *E. argyrogaster* was poor. Individuals usually made several forage flights before successfully ensnaring prey. Prey were collected only from the air; and, in all cases where prey capture was observed, prey were already impaled on the asilid's proboscis when it landed. Most forage flights were 1.5–3 m in length, however a few were shorter, such as when a male took a spider in the act of jumping off a rock. Movement discrimination in this species seemed to be excellent, as evidenced by asilids turning to face birds flying overhead.

Once captured, prey were infrequently manipulated during the feeding process. The asilid would hover 2–5 cm above the substrate and manipulate the prey with all six tarsi. Prey could be manipulated as many as three times during a single feeding. This type of manipulation is typical of all *Efferia* which have been studied (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976) and is probably a generic trait.

Most prey were relatively small, were not manipulated, and during feeding

would remain impaled on the predator's proboscis with no tarsal support. During feeding, the prey were commonly ballooned, as described for *Efferia helenae* (Bromley) by Lavigne and Holland (1969).

Upon completion of feeding, prey were handled in much the same manner as that used by *Efferia benedicti* (Bromley) (Lavigne et al., 1976). In most cases, prey were dropped off the proboscis on site, presumably by a movement of the mouthparts. In one instance, however, the fore tarsi were used to accomplish this. On another occasion, a female flew out 2.5 cm from the feeding site, hovered, and dropped the prey; while in two other instances, asilids dropped the prey en route to new foraging sites.

In the following prey records, the sex of the predator is indicated in parentheses following the prey record.

Prey taken by *Efferia argyrogaster*: ARANEIDA: Unidentified, III-28-72 (♂). COLEOPTERA, Bruchidae: *Stator vachelliae* Bottimer, III-28-72 (♂); Chrysomelidae: *Babia tetraspilota* LeConte, III-25-72 (♀), III-26-72 (♀), III-27-72 (1 ♂, 1 ♀); Scarabaeidae: *Aphodius vittatus* Say, III-28-72 (♀). DIPTERA, Bombyliidae: *Poecilanthrax arethusa* (Osten Sacken), III-25-72 (♀); Muscidae: *Musca domestica* L., III-25-72 (♀), III-27-72 (1 ♂, 2 ♀); Tachinidae: *Acroglossa hesperidarum* (Williston), III-28-72 (♀); *Deopalpus hirsutus* Townsend, III-25-72 (♂). HEMIPTERA, Alydidae: *Alydus eurinus* (Say), III-24-72 (2 ♀), III-27-72 (♀); *Stachyocnemus apicalis* (Dallas), III-25-72 (♀), III-27-72 (2 ♂); Lygaeidae: *Ligyrocoris litigiosus* (Stål), III-26-72 (♂); Rhopalidae: *Arhyssus lateralis* (Say), III-24-72 (♂); *Niesthrea sidae* (Fabricius), III-24-72 (♀). HOMOPTERA, Cicadellidae: *Acinoptera* sp., III-27-72 (♀), undetermined, III-25-72 (♂). HYMENOPTERA, Pompilidae: *Ageniella arcuata* (Banks), III-27-72 (♀); *Ageniella* sp., III-25-72 (♀); *Cryptocheilus pallidipennis* (Banks), III-24-72 (♀); Sphecidae: *Dryudella caerulea* (Cresson), III-28-72 (♀); *Tachysphex* sp., III-27-72 (♂); Vespidae: *Polybia occidentalis* (Oliver), III-24-72 (♀), III-25-72 (♂); III-27-72 (2 ♂, 4 ♀), III-28-72 (2 ♂, 2 ♀). LEPIDOPTERA, Lycaenidae: *Hemiargus ceraunus* (Fabricius), III-26-72 (♀); Lyonetiidae: *Bucculatrix* sp., III-27-72 (♀); Noctuidae: *Lacinipolia* sp., III-27-72 (♂); Nymphalidae: *Phyciodes campestris* (Behr), III-28-72 (♀); Pieridae: *Eurema lisa* Boisduval and LeConte, III-27-72 (♂); *Eurema nicippe* (Cramer), III-28-72 (♂); Pyralidae: *Tetralopha robustella* (Zeller), III-26-72 (♂); Scythridae: *Scythris* sp., III-26-72 (♂).

Like most other *Efferia* studied (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976), *E. argyrogaster* is euryphagic. The prey taken by 21 males and 29 females represent seven orders, 21 families, and 26 genera. Of the 50 recorded prey, 34% belong to the order Hymenoptera, 18% to the order Hemiptera, 16% to the order Lepidoptera, 14% to the order Diptera, 12% to the order Coleoptera,

Table 1. Orders of insects preyed upon by *Efferia argyrogaster* (%) based on sex of the predator.

Predator	Coleoptera	Diptera	Hemiptera	Homoptera	Hymenoptera	Lepidoptera	Araneae
Male	9.5	9.5	19	4.7	28.6	24	4.7
Female	13.8	17.2	17.2	3.5	37.9	10.4	0
Mean	12	14	18	4	34	16	2

4% to the order Homoptera, and 2% to the spiders (Araneae). Unlike for other *Efferia* species, the list of recorded prey is dominated by stinging Hymenoptera, which apparently this species of *Efferia* can overpower due to its large size. Thirteen (26%) prey were the vespid, *Polybia occidentalis*.

When prey records are separated at the order level on the basis of sex of the predator, there seems to be little difference in preference between sexes. Females showed a slightly greater preference for Diptera and Hymenoptera, whereas males showed a slight preference for Lepidoptera (Table 1).

The mean predator to prey size ratio for *E. argyrogaster* is 2.5 (Table 2). While females are larger than the males, they tend to catch slightly smaller prey than do the males. Females thus have a larger mean predator to prey size ratio than do males (i.e., 2.8 and 2.2, respectively).

Mating behavior in this species is very simple and is not preceded by courtship maneuvers in the immediate vicinity of the female. Like other *Efferia* (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976), males do exhibit an undulating flight in search of females, landing intermittently. When another asilid flies by, the male flies after it and makes contact. If the contacted individual is a male, the pair separate and they fly off in different directions. If the encountered individual is a female, the pair grapple and fall, with copulation taking place on the soil surface. The position taken is that of male-over-female with the female's wings spread about 45° and male's fore tarsi resting on the female's eyes (Fig. 2).

Two matings were observed in their entirety. One was initiated at 10:24

Table 2. Relation between length of *Efferia argyrogaster* and that of its prey.

Sex	Predator Length (mm)			Prey Length (mm)			No. of Prey Measured	Mean Ratio of Predator to Prey
	Min	Max	Mean	Min	Max	Mean		
Male	17.8	22.1	20.4	3.3	21.5	9.2	21	2.2
Female	20.8	25.6	22.9	3.3	16.1	8.3	29	2.8
Mean	17.8	25.6	21.5	3.3	21.5	8.7	50	2.5



Fig. 2. Mating pair of *Efferia argyrogaster*.

AM and lasted 6 minutes; the other was initiated at 11:51½ AM and lasted 7½ minutes. Once the mating position was achieved, both pairs flew to dead maize stalks where they took up a resting position at a height of about 20 cm. Temperatures at that height were 26.7°C and 30°C, respectively. Four other mated pairs were observed on stalks, ranging in height from 2.5 cm to 30 cm. Temperatures at these heights at the times the mated pairs were observed were 28.3°C (11:57 AM), 31°C (12:42 PM), 32.2°C (3:04 PM) and 32.2°C (4:15 PM).

Little movement occurs during copulation. Just prior to the completion of mating, the male starts to move his hind legs slowly, rubbing them against the sides of the basal abdominal segments of the female. While this is occurring, the male initiates an extended audible wing vibration. In one instance, the buzzing lasted about 10 sec, in another about 45 sec and in a third instance, the male buzzed his wings 3 sec, stopped, buzzed 30 sec,

→
Fig. 3 Female *Efferia argyrogaster* ovipositing between leaf and stalk of broken grass plant.

Fig. 4. Eggs of *Efferia argyrogaster* deposited between leaf and stalk of grass plant.



stopped, and buzzed the wings about 1 sec. At the end of the wing buzzing, the male released his hold on the female, fell off to the side, released his claspers, and flew away.

As would be expected from the shape of the ovipositor (long, narrow, and laterally compressed), *E. argyrogaster* females deposited eggs in available niches in dead, dry vegetation. The commonest site chosen was between the leaf sheath and stem of grass plants (Fig. 3). However, some eggs were deposited inside a circlet of dried sepals of a forb, between bract and stem of a woody plant, and inside a curled dried leaf. In one instance, a female utilized a hollowed out seed, inserting the eggs through the opening left by an unknown seed predator. Prior to oviposition, females used their ovipositors to probe for suitable sites, beginning near the bottom and working their way up dead stalks. Most eggs were deposited at heights of 5–18 cm above the soil.

Individual ovipositions took from 30 to 90 seconds. Eggs were cemented together and their numbers varied from 2–19 per clutch. On one occasion, the same female was observed making six egg depositions over a period of 18 minutes, having previously probed several stalks for 50 minutes. The number of eggs deposited at each site was 5, 10, 4, and 22, for a total of 41 eggs.

Observed oviposition behavior occurred between 11:45 AM and 2:00 PM, with one exception at 3:26 PM. Temperatures at the height of egg deposition varied between 31–33°C.

Efferia argyrogaster eggs are creamy white. They vary in length from 1.0 to 1.3 mm with an average of 1.2 mm. The average width is 0.4 mm (Fig. 4).

ACKNOWLEDGMENTS

I should like to express my appreciation to the following taxonomists of the Systematic Entomology Laboratory, USDA, for identifying most of the varied insects used as prey by this species of asilid: D. C. Ferguson, R. J. Gagné, R. D. Gordon, J. L. Herring, J. M. Kingsolver, L. Knutson, J. P. Kramer, A. S. Menke, C. W. Sabrosky, R. E. White. Identifications also were provided by D. R. Davis of the Department of Entomology, Smithsonian Institution and C. D. Ferris, University of Wyoming.

LITERATURE CITED

- Dennis, D. S. and R. J. Lavigne. 1976. Ethology of *Efferia varipes* with comments on species coexistence (Diptera: Asilidae). J. Kans. Entomol. Soc. 49:48–62.
Hine, J. S. 1919. Robber flies of the genus *Erax*. Ann. Entomol. Soc. Am. 12:103–157.
Lavigne, R. J. and D. S. Dennis. 1975. Ethology of *Efferia frewingi* (Diptera: Asilidae). Ann. Entomol. Soc. Am. 68:992–996.

- Lavigne, R. J. and F. R. Holland. 1969. Comparative behavior of eleven species of Wyoming robber flies (Diptera: Asilidae). Wyo. Agric. Exp. Stn. Sci. Monogr. 18:1-61.
- Lavigne, R. J., L. Rogers, and F. Lavigne. 1976. Ethology of *Efferia benedicti* (Diptera: Asilidae) in Wyoming. Proc. Entomol. Soc. Wash. 78:145-153.
- Macquart, J. 1846. Diptères exotiques. Nouveaux ou peu connus. Librairie Encyclopédique de Roret, Paris. Pp. 84-85.